LEIBNIZ INSTITUTE FOR BALTIC SEA RESEARCH WARNEMÜNDE

Date: 01.08.16

Cruise Report

R.V. Poseidon Cruise No.: POS501

Dates of Cruise: from 13.06.2016 to 01.07.2016

Areas of Research: Biogeochemistry, Physical Oceanography, Maritime Technology

Port Calls: Malaga (Spain), Ponta Delgada (Portugal)

Institute: Leibniz Institut für Ostseeforschung Warnemünde, Seestraße 15, 18119 Rostock

Chief Scientist: Prof. Dr. Joanna Waniek

Number of Scientists: 8

Project: DFG: WA2157/5-1, BMWI: 03SX276 A/B

Cruise Report

This cruise report consists of 17 pages including cover:

1. Scientific crew:

Name	Function	Institute	Cruise/Leg
Prof. Dr. Joanna Waniek	Chief scientist	IOW	501
Ingo Schuffenhauer	Technician	IOW	501
Martin Kolbe	Technician	IOW	501
Judidth Stern	Scientist	IOW	501
Arne Estelmann	Student	IOW	501
Helena Frazao	Student	Un. Lisbon	501
Oleksiy Kebkal	Scientist	Evologics	501
Georgiy Pleskach	Scientist	Evologics	501
Total : 8			

IOW Leibniz Institut für Ostseeforschung Warnemünde

Evologics Evologigs GmbH, Berlin

Univ. Lisbon Marine and Environmental Sciences Centre, Lissabon

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2. Research program (J. Waniek, IOW)

The research program and the aims of the cruise mirror the plans of both involved projects (DECADE & SMIS) and are depicted in the working plan of the expedition: By means of hydrographic work the physical and biogeochemical conditions in the entire water column in the catchment area of Kiel276 were registered. Those CTD and ScanFish (towed CTD) registrations were used to locate the Azores Front along four meridians (23°W, 22°W, 21°W and 20°W) between 30°N and 37°N allowing for a 3-D mapping of the front and resulting biogeochemical conditions. Additionally, extensive acoustic trials were carried out, allowing for assessment of functionality and performance of different modems in various configurations.

3. Narrative of the cruise with technical details (J. Waniek, IOW)

12.06.2016- In the morning the cruise participants embark the ship and after uploading the containers started setting up the laboratories and testing the gear.

13.06.2016 - At 12:00 UTC after safety instruction Poseidon left the port of Malaga and started the transit to our working area at 36°N, 20°W. Our estimated arrival time in the working area is the morning of 17th June.

14.06-16.06.2016-Transit to our working area under relatively good weather and sea conditions, with winds below 10 ms^{-1}.

17.06.-18.06.2016- Hydrographic work started at 36°N, 20°W with a CTD down to the bottom and continued southwards along 20°W with CTDs every 30 or 60 nm combined with acoustic trials (Fig. 1). The front was hit already with the first CTD and located between 35°N and 36°N.

19.06.-22.06.2016- Those three days were filled with hydrographic work (CTDs) along 21°W towards North (Fig. 1). The transect runs from 32°N to 37°N with the front located at 35.5°N.

23.06.-26.06.2016- The days were used for hydrographic work by means of CTD along 22°W combined with turbulence measurements at selected position, and ScanFish tow, allowing for higher resolution registration of the hydrographic properties (T, S, O_2, chl *a* fluorescence) in the upper 200 m in the frontal area. The front was located between 34.5°N and 35°N. Most of the CTD casts were done over full depth and samples taken for a variety of parameters. Occasionally the CTD winch was having some technical problems, causing some delay in the station work.

26.06.-30.06.2016- Under relative good weather and sea conditions (on average no stronger than 6 Bft, and waves of less than 2 m) the hydrographic work continued along 23°W, with CTD, turbulence probe and ScanFish deployments. CTD casts were run down to the bottom or 500 m water column, depending on the visual inspection of the profiles. At most stations acoustic modems test without additional time requirements were performed. The Azores Front was located north of 35°N.

30.06.2016- The station work of the cruise finished at 36°N, 23°W at 11:00 UTC and RV Poseidon headed towards Ponta Delgada.

01.07.2016- RV Poseidon reached Ponta Delgada in the morning and the cruise POS501 terminated here. The cruise participants started to load the container, and disembarked at 11:00 UTC.

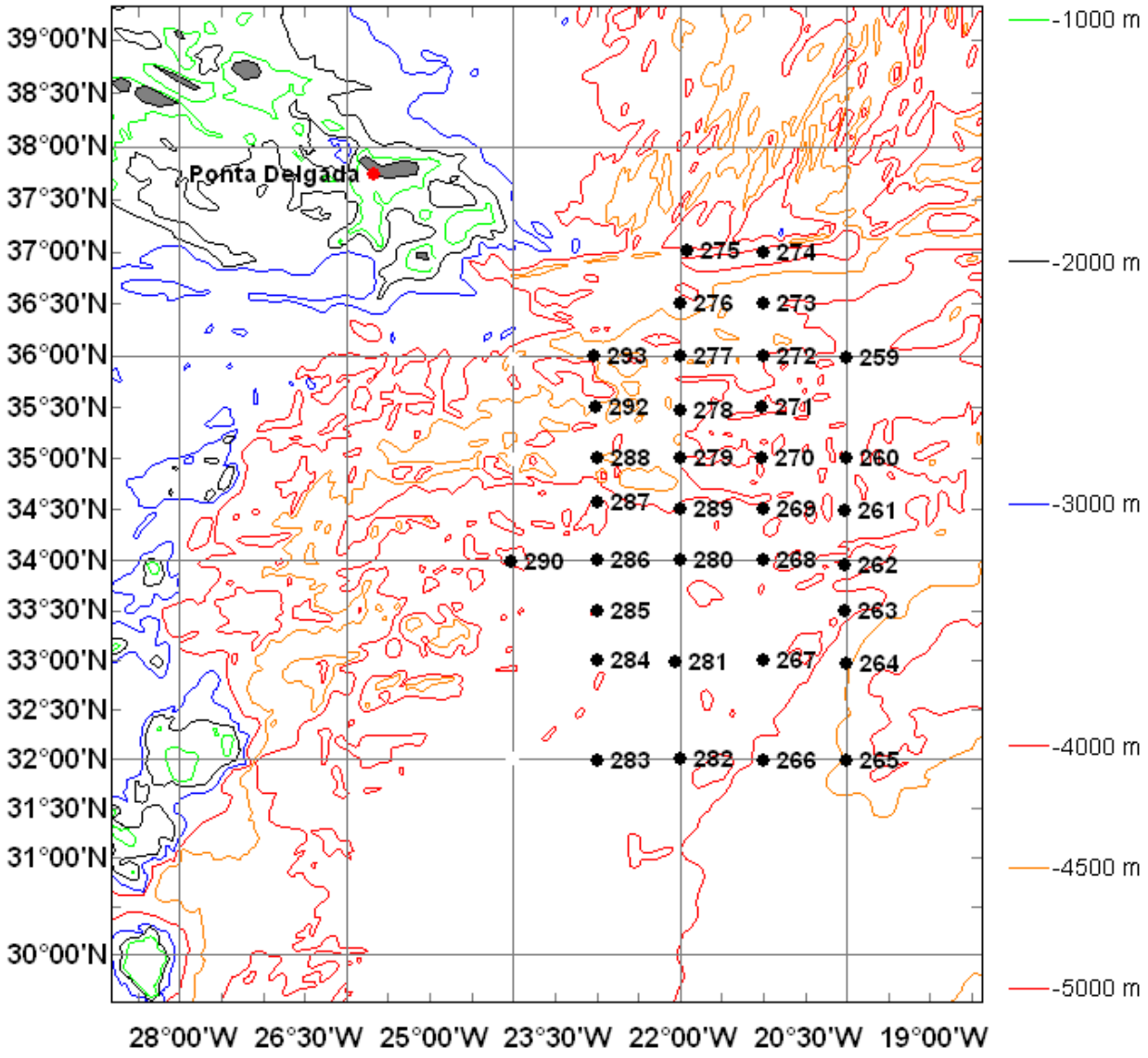

Fig. 1: Cruise track of POS501 in June 2016 from Malaga (Spain) to Ponta Delgada (Portugal). Numbers indicate the positions of hydrographic stations (CTDs). Color lines indicate water depth according to ETOPO5.

4. Scientific report and first results

4.1 Hydrographic sections (J. Waniek, A. Estelmann, J. Stern, I. Schuffenhauer, M. Kolbe, (all IOW), H. Frazao (Univ. Lisbon))

The main objective of the cruise POS501 was to investigate the water column properties along four meridians (23°W, 22°W, 21°W and 20°W) between 30°N to 37°N in order to locate the Azores Front and to understand the changes in the biogeochemical properties corresponding to the frontal area (Fig. 1).

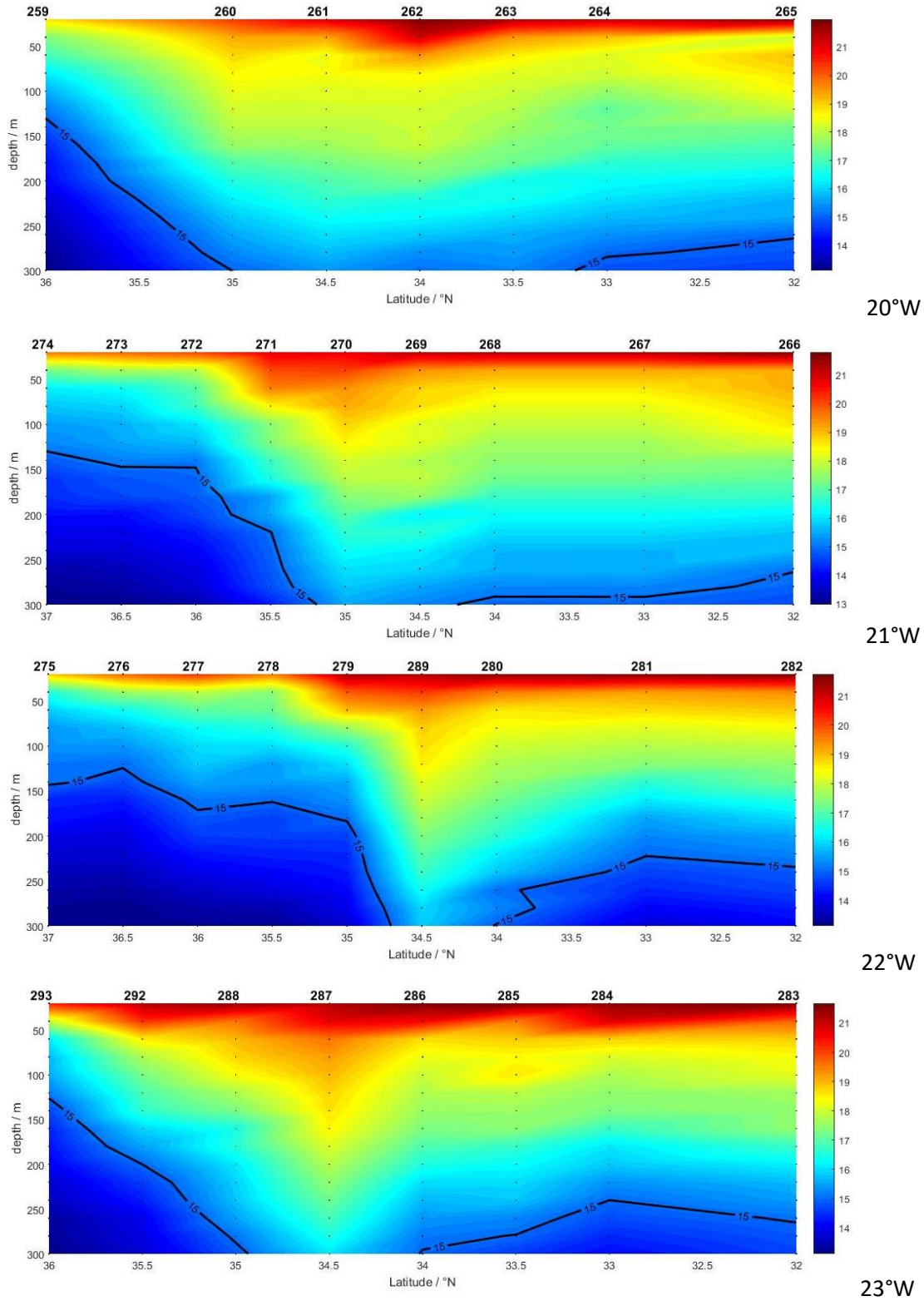

Fig. 2: Vertical temperature distribution in the upper 300 m depth during the POS501 cruise in June 2016 along the meridians 20°W-23°W. The 15°C isotherm is marked black, highlighting the Azores Front by lifting up from below 300 m to above 200 m. CTD stations are indicated on top.

To detect the Azores Front, in-situ measurements of at least temperature and salinity are necessary, because the front does not have any surface indication (see figure 2) and therefore cannot be detected via remote sensing. The position of the frontal system is typically defined through the 15°C isotherm upward movement from 300 m to above 200 m depth. For this purpose, CTD measurements were done at pre-selected positions every 30 nm or 60 nm along the meridians 20°W, 21°W, 22°W and 23°W (Fig. 2).

Figure 2 shows the vertical temperature distribution in the upper 300 m of the water column along all four meridians, clearly indicating that since the cruise last May (POS485 in 2015) the front moved almost 1 to 1.5 degree towards north, when comparing the AF position at sections 21°W and 22°W from 2015 and 2016. Assuming that the AF did not change the propagation direction over the past year, this difference in AF position is corresponding to a propagation speed of roughly 8 cms^{-1} (Fig. 2).

However, the work is still ongoing and further analyses of the hydrographic sections, especially in comparison to observations carried out in recent past (since 2005) are ongoing and will give insight into 1) the dynamics of the frontal system on inter-annual time scale, 2) describe the 3-D Structure of the front and 3) together with the results of the laboratory analyses of the collected samples allow to assess the impact of the frontal system on the particles dynamics in the subtropical NE Atlantic.

4.2 High resolution mapping of the front along 22°W (I. Schuffenhauer, M. Kolbe, A. Estelmann, J. Waniek, IOW)

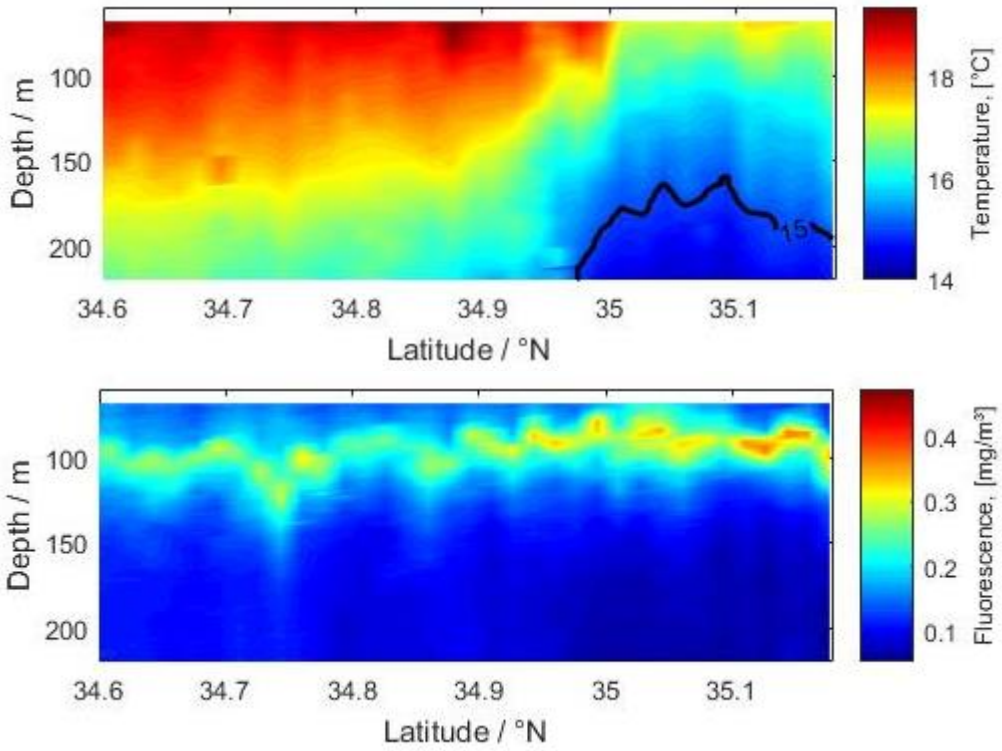

Fig. 3: Vertical temperature and chlorophyll a fluorescence distribution between 70 m and 220 m depth during the POS501 cruise in June 2016 along the meridians 22°W recorded with ScanFish. The 15°C isotherm is marked black, highlighting the Azores Front by lifting up from below 300 m to above 200 m.

ScanFish, a towed CTD devise with a fluorescence probe was used to monitor the front with higher spatial resolution between 34.6°N and 35.18°N along 22°W and 70 m to 220 m depth, allowing for a more precise localization of the Azores Front (Fig. 3). Comparing the temperature distribution recorded with ScanFish to the section created based on CTD cast, it is clear that more detailed structure is visible especially regarding the 15°C isotherm (compare fig. 2 at 22°W and figure 3 upper panel).

The measurements indicate also that the subsurface chlorophyll a maximum is changing it vertical position in relation to the front, being located deeper south of the front and moving towards shallower depth at the front itself. The DCM is stronger above the front, most likely due to greater nutrient supply in this region (Fig. 3). Fründt and Waniek (2012) already argued that way, however the data to prove this hypothesis were sparse at that time.

Unfortunately, the used ScanFish did not allow to record any measurements below 220 m at least until 300 m because of system limitations (cable length, winch), but we are planning to repeat those measurements on a next cruise with a modified system.

4.3 Geostrophic currents (H. Frazao, Univ. Lisbon, J. Waniek, IOW)

Deep CTD casts along 22°W were used to compute geostrophic velocities relative to 3000 m (level of no motion (LoNM)). To calculate the geostrophic velocity the stations numbers 277, 279, 281 and 282 with depths greater than 3000 m were used. This method includes the computation of dynamic height anomaly (the integral of the specific volume anomaly from the pressure at each level relative to the reference LoNM). In our calculation the geostrophic velocity normal to the meridional section along 22°W between 32°N and 36°N is positive to the west (Fig. 4).

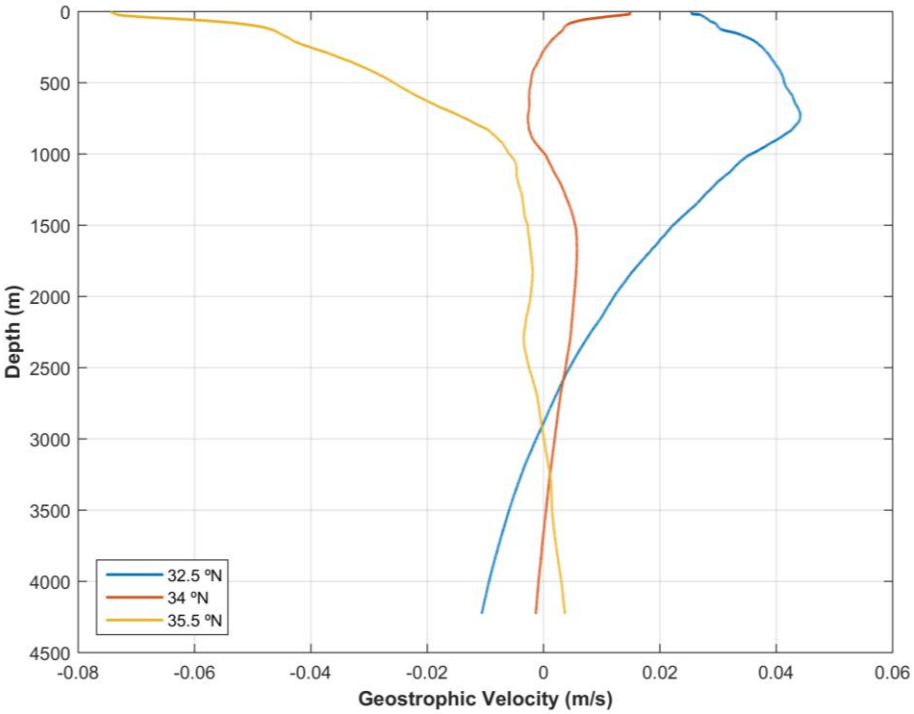

Fig. 4: Geostrophic velocity profiles (ms^{-1}) relative to 3000 m at selected positions along 22°W. Positive values are to the west.

At 35.5°N the geostrophic currents has a maximum velocity to the east at the surface (~8 cms^{-1}), which declines rapidly down to 3000 m and changes towards west below 3500 m depth. Near the bottom weak westward flow exist (< 1 cms^{-1}). The profile at 34°N corresponds to the transition zone, with velocities near zero in the entire water column. Further south (32.5°N) the geostrophic velocity is to the west with a maximum near 800 m of roughly 4 cms^{-1}, probably corresponding to the Mediterranean Water outflow. Near the bottom, the geostrophic current has weak values to the east.

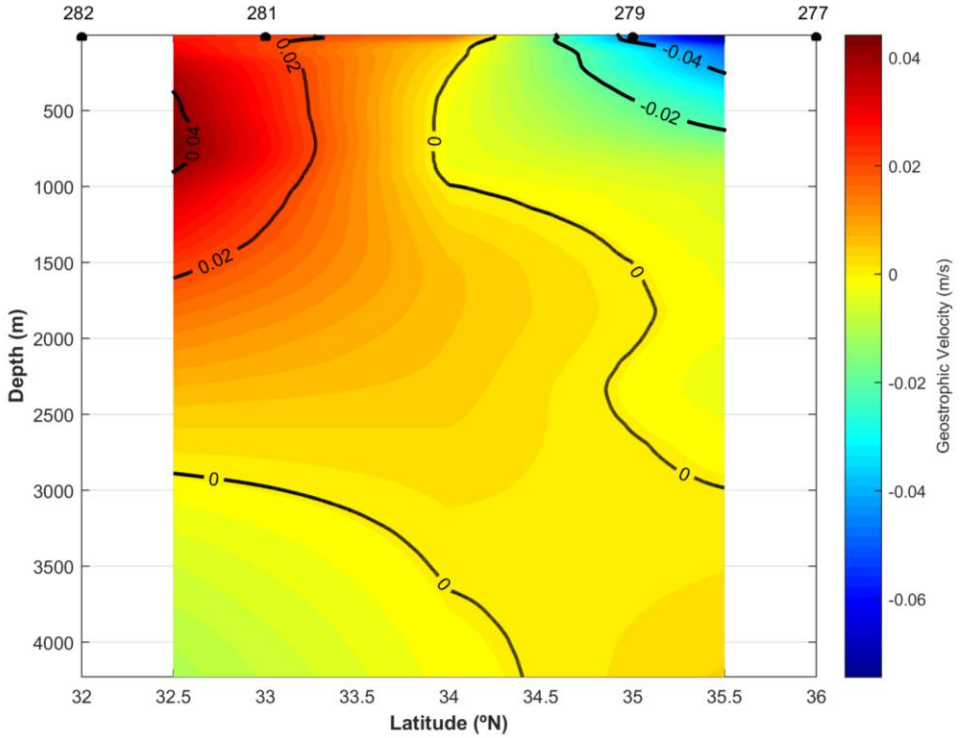

Fig. 5: Geostrophic velocity (ms^{-1}) with level of no motion set to 3000 m depth within the entire water column along 22°W. Positive values are to the west. The velocity contours have an increment is 0.02 ms^{-1}.

The meridional section of geostrophic currents along 22°W in the entire water column is shown in Fig. 5. The negative geostrophic velocity in the surface near 500 m between 34.5°N and 35.5°N is associated with the eastwards flowing branch of the Azores Current. The Azores Front itself based on CTD data and ScanFish registration was located just south of the eastward flow at the northern end of the section between 34.95°N and 35°N (see figure 2 and 3). Between station 279 and 281 the geostrophic currents changes their direction and are westwards at station 281.

4.4 Long range underwater acoustic communication (O. Kebkal, G. Pleskach, Evologics)

The acoustic trials were aimed for testing the performance of newly developed acoustic transducers (omnidirectional and directional) for long-range S2C (Sweep-Spread Carrier) modem units. The trials comprised proving the ability of S2C modems, equipped with new low-frequency transducers, to communicate over 5 km distances in open water under real deployment conditions, testing the new omnidirectional transducers. Some of the ship-side devices, prepared for the tests, were equipped with

USBL-antenna, allowing to estimate position of the remote unit. Important aspect of the performance testing was to analyze compatibility and performance of acoustic modems with different combinations of directional and omnidirectional transducer, operating in the same frequency range.

Fig. 6. Acoustic modem S2C 7/17D mounting frame on the ship side (left) and S2C 7/17D modem mounted on a CTD rosette.

At the first stage, two S2C 15/27 modems were used during directional transducer testing, one of them mounted on the ship bottom approx. 5 m deep, the other mounted on a CTD rosette (Fig. 6). Directional transducers showed good bitrate and positioning performance and enabled a stable communication link between modems over range exceeding 5 km (maximal communication distance 5150 meters).

Next, a similar scheme was used to test S2C 7/17 modems with 3 different type of directional and omnidirectional transducers. Communication messages were sent from a top-side modem, located at the ship bottom, to a down-side modem, lowered on a CTD rosette. The down-side modem responded on the successfully demodulated message with ACK, making the established acoustic link bidirectional. Compared to the directional versions, the omnidirectional transducers' sensitivity to ambient noise was higher, reducing the operating range and impairing the performance of the modems.

Communicating over a 5 km range with S2C 7/17 modems showed good performance and stability in the case, where directional top-side modem was used (maximal communication distance 5155 meters). If omnidirectional version of the S2C 7/17 was used on the ship side, the communication over a 5 km range was proven possible only under lower noise conditions.

At the last stage of trials, two directional S2C 15/27 modems were mounted as in the previous scenarios. The task was to test communication performance of 2 different communication techniques on these modem – standard and newly developed experimental technique, transmitting long data messages. Using both communication techniques, modems provided stable data link with nominal

bitrate up to 9 kbps and average bitrate over 5 kbps and range over 5 km. Obtained experimental data for the new technique provides important data for future improvement of the new technique, including an on fly adaptation to the relative velocity variations of the transmitter and receiver. Obtained experimental results confirmed numerically modeled performance. Tested devises can be recommended as communication and positioning means for future projects.

5. Scientific equipment, moorings and instruments

5.1. CTD (I. Schuffenhauer, M. Kolbe, IOW)

During the cruise a CTD system composed of SBE9plus and a 13 Hydrobios free flow bottles of 5L each was used. The CTD had additionally a second temperature and conductivity sensor and sensors for dissolved oxygen, turbidity and chlorophyll a as well mounted and an altimeter devise to detect the bottom. Almost all cast were carried out over the full water depth (see list of stations in the appendix for additional details). After initial problems with some of the connecting cables, the entire system runs smoothly. In total 34 CTD profiles of 5000 m or more were obtained during the cruise.

5.2. ScanFish (I. Schuffenhauer, IOW)

The ScanFish (SF) is a towed undulating vehicle with high payload, allows to fit several different pieces of equipment. The SF was equipped with a Seabird CTD System SBE911plus, with temperature-, conductivity- and oxygen-sensor and a wetlabs FLNTURTD for Fluorescence and Turbidity.

Tab. 1 Technical specifications of the ScanFish.

Length	0.90 m
Height	0.26 m
Width	1.80 m
Weight air/water	75/0 kg
Colours	Bright yellow and orange
Performance	
Depth range	400 m
Undulation range	With winch control: 0-400 m (full depth)
Towing speed	4-10 knots
Dive/climb speed	0-2 m/sec
Anti-collision climb	3 m/s = 45° at 6 knots
Vertical position precision	0.2 m
Roll precision	0.5°
Max slope, terrain-following mode	20°
Payload	50 kg – depending on equipment volume
Bandwidth	Up to 7 Mbit/s with 1,000 m cable
EIVA ScanFish III Flight bandwidth usage	50 Kbit/s

The ScanFish permits underway acquisition and continuous processing of real-time, data. SF has three operation modes and an intelligent anti-collision feature. Its pattern is therefore easily adjusted to ensure well-founded results of the survey task at hand. The undulation operation mode allows for profiling of the water column in a V-curved path at a steady velocity and thus even data acquisition. Adding to this, the possibility of enabling either terrain-following or fixed depth mode, is possible allowing complete control of the position of the vehicle and adjusting the deployment at all times to the requirements. We have used the SF in the undulating mode between 70 m and 220 m depth at a ship speed of 4 knots.

5.3 Water Sampling (J. Waniek, A. Estelmann, J. Stern, IOW)

During the cruise samples for a number of parameters were taken at selected depth. The sampling depth were selected according to the registered profiles of T, S, chlorophyll a fluorescence and O_2. In the upper 200 m of the water column the depth were chosen by considering the chlorophyll a profile, below 200 m the sampling depth were chosen according to water mass distribution and/or special features observed in the respective CTD cast. At the majority stations samples were taken for: suspended particulate matter (SPM), chlorophyll a (chla), inorganic nutrients, particulate organic carbon (POC), dissolved organic carbon (DOC), $\delta^{13}C$, and $\delta^{18}O$. Samples for SPM, POC and chlorophyll a were filtered of GFF filters and the filters stored frozen for analyses in home laboratory. For nutrients and DOC filtrated water was filled into the flask and frozen by -20°C until analyses in home laboratory.

5.4 Microstructure measurements (I. Schuffenhauer, IOW)

At selected positions (see Appendix station list) microstructure measurements with the MSS probe from the group Dr. M. Dengler (GEOMAR) down to 400 m were carried out. The stations were chosen relative to the frontal system, with stations 277 and 288 being in the Azores Front or close by, stations 281 and 284 south of the front and station 274 north of it.

The microstructure profiler measures velocity shear and temperature variability on vertical scales of less than a millimeter and simultaneously records other physical parameters in the water column. Therefore the probe operates with a very high sampling rate of 1024 Hz and is equipped with two shear probes (airfoil), a fast temperature sensor (microthermistor), an acceleration sensor, tilt sensors as well as the standard CTD sensors which measure temperature, conductivity and pressure with a lower sampling rate of 24 Hz. The profiler is a free falling device, which ideally is adjusted to descend at a rate of 0.6 ms^{-1} in order to optimize the data processing of the airfoil probes. The probe transmits the data via a cable to the deck unit and directly stores the measurements. The cable is veered with a special winch.

6. Acknowledgements

We thank Captain M. Günther and the crew of R/V Poseidon for their support and help during this cruise.

7. Appendices

Appendix B: List of stations

Station	Date	Time UTC	Lat degree	Lon degree	Depth [m]	Wind [dir, m/s]	Course [°]	Speed [knots]	Gear/Abbreviation	Action
Beginn der Forschungs- und Stationsarbeiten POS 501										
POS501/259-1	17.06.16	07:56	36° 00,01' N	019° 59,98' W	5287,5	NNE 6	92,0	0,4	CTD/rosette water samplerCTD/RO	zu Wasser 07:55
POS501/259-1	17.06.16	08:08	36° 00,01' N	019° 59,99' W	5287,6	NE 7	303,4	0,3	CTD/rosette water samplerCTD/RO	an Deck
POS501/259-1	17.06.16	08:10	36° 00,01' N	020° 00,00' W	5290,9	NNE 7	246,1	0,3	CTD/rosette water samplerCTD/RO	zu Wasser
POS501/259-1	17.06.16	09:51	36° 00,00' N	019° 59,95' W	5293,6	N 6	261,0	0,1	CTD/rosette water samplerCTD/RO	auf Tiefe SL max 5404 m
POS501/259-1	17.06.16	11:58	35° 59,98' N	020° 00,00' W	5291,4	N 6	187,0	0,4	CTD/rosette water samplerCTD/RO	an Deck
POS501/260-1	17.06.16	22:15	35° 00,05' N	019° 59,91' W	5170,4	NE 7	61,7	0,4	CTD/rosette water samplerCTD/RO	zu Wasser
POS501/260-1	17.06.16	23:58	35° 00,31' N	019° 59,90' W	5171,6	NE 7	278,2	0,1	CTD/rosette water samplerCTD/RO	auf Tiefe SLmax: 5273 m
POS501/260-1	18.06.16	01:46	35° 00,29' N	019° 59,92' W	5172,2	NNE 6	41,7	1,2	CTD/rosette water samplerCTD/RO	an Deck
POS501/261-1	18.06.16	05:25	34° 29,99' N	020° 00,00' W	5102,1	ENE 8	97,8	0,5	CTD/rosette water samplerCTD/RO	zu Wasser
POS501/261-1	18.06.16	05:30	34° 29,97' N	019° 59,98' W	5102,5	NE 8	88,6	0,2	CTD/rosette water samplerCTD/RO	auf Tiefe SL max 184m
POS501/261-1	18.06.16	05:35	34° 29,99' N	019° 59,96' W	5100,7	NE 8	81,0	0,2	CTD/rosette water samplerCTD/RO	an Deck
POS501/261-2	18.06.16	05:41	34° 29,98' N	019° 59,99' W	5103,2	NE 8	270,5	1,1	CTD/rosette water samplerCTD/RO	zu Wasser
POS501/261-2	18.06.16	07:14	34° 29,97' N	020° 00,02' W	5100,6	NE 10	117,5	0,5	CTD/rosette water samplerCTD/RO	auf Tiefe SL max 5209 m
POS501/261-2	18.06.16	08:56	34° 29,98' N	019° 59,83' W	0,0	NE 8	182,2	0,2	CTD/rosette water samplerCTD/RO	an Deck
POS501/261-3	18.06.16	09:09	34° 30,00' N	019° 59,84' W	5101,0	ENE 9	5,4	0,6	Micro structure probe MSS	zu Wasser
POS501/261-3	18.06.16	09:09	34° 30,00' N	019° 59,84' W	5101,0	NE 9	5,4	0,6	Micro structure probe MSS	an Deck
POS501/261-3	18.06.16	09:11	34° 30,02' N	019° 59,81' W	5102,2	ENE 8	25,6	1,1	Micro structure probe MSS	zu Wasser
POS501/261-3	18.06.16	09:13	34° 30,04' N	019° 59,79' W	5101,8	ENE 9	32,6	0,8	Micro structure probe MSS	an Deck
POS501/261-3	18.06.16	09:15	34° 30,07' N	019° 59,77' W	5100,4	ENE 9	33,1	0,8	Micro structure probe MSS	zu Wasser
POS501/261-3	18.06.16	09:17	34° 30,08' N	019° 59,75' W	5153,9	NE 8	49,7	0,9	Micro structure probe MSS	an Deck
POS501/262-1	18.06.16	12:52	34° 00,06' N	020° 00,00' W	5123,0	ENE 9	122,5	0,4	CTD/rosette water samplerCTD/RO	zu Wasser
POS501/262-1	18.06.16	14:26	34° 00,00' N	020° 00,02' W	5126,1	ENE 9	142,2	0,1	CTD/rosette water samplerCTD/RO	auf Tiefe SL max. 5232m
POS501/262-1	18.06.16	16:05	34° 00,00' N	020° 00,00' W	5123,6	ENE 9	286,1	0,1	CTD/rosette water samplerCTD/RO	an Deck
POS501/263-1	18.06.16	20:10	33° 30,02' N	020° 00,04' W	4924,1	ENE 7	39,2	0,4	CTD/rosette water samplerCTD/RO	zu Wasser
POS501/263-1	18.06.16	21:35	33° 30,01' N	020° 00,02' W	0,0	ENE 9	211,6	0,3	CTD/rosette water samplerCTD/RO	auf Tiefe SL max 4850 m
POS501/263-1	18.06.16	23:13	33° 30,07' N	019° 59,96' W	4937,3	ENE 9	341,5	0,2	CTD/rosette water samplerCTD/RO	an Deck

POS501/264-1	19.06.16	03:17	33° 00,01' N	020° 00,00' W	4587,6	ENE 10	286,0	0,0	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/264-1	19.06.16	04:41	33° 00,02' N	019° 59,98' W	4586,2	ENE 8	185,6	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 4693m
POS501/264-1	19.06.16	06:07	33° 00,01' N	020° 00,06' W	4598,1	NE 7	221,1	0,0	CTD/rosette water sampler	CTD/RO	an Deck
POS501/265-1	19.06.16	12:03	32° 08,40' N	019° 59,99' W	4389,4	NE 8	186,7	2,1	Scan-Fish SCF		zu Wasser
POS501/265-1	19.06.16	12:11	32° 08,08' N	020° 00,01' W	4389,9	NE 8	183,7	3,5	Scan-Fish SCF		Start Profil
POS501/265-1	19.06.16	12:36	32° 06,35' N	020° 00,01' W	4393,1	NE 9	179,7	4,2	Scan-Fish SCF		Ende Profil
POS501/265-1	19.06.16	12:44	32° 06,01' N	020° 00,01' W	4389,1	NE 9	186,2	1,9	Scan-Fish SCF		an Deck
POS501/265-2	19.06.16	13:44	32° 00,04' N	020° 00,03' W	4470,4	ENE 8	230,7	0,1	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/265-2	19.06.16	15:14	32° 00,02' N	020° 00,02' W	4470,1	NE 8	0,5	0,9	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max: 4554 m
POS501/265-2	19.06.16	16:41	31° 59,98' N	020° 00,04' W	4570,8	NE 9	163,1	0,5	CTD/rosette water sampler	CTD/RO	an Deck
POS501/265-3	19.06.16	17:07	32° 00,02' N	019° 59,94' W	4468,6	NE 10	40,0	2,0	Scan-Fish SCF		zu WasserGerätetest
POS501/265-3	19.06.16	17:24	32° 00,42' N	020° 00,31' W	4466,4	NE 11	269,6	2,7	Scan-Fish SCF		an Deck
POS501/266-1	19.06.16	23:22	31° 59,94' N	021° 00,08' W	4853,9	NE 6	16,5	0,7	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/266-1	20.06.16	00:57	32° 00,06' N	020° 59,99' W	4851,3	ENE 7	117,9	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max: 4948 m
POS501/266-1	20.06.16	02:27	32° 00,11' N	020° 59,88' W	4886,6	NE 4	45,2	0,8	CTD/rosette water sampler	CTD/RO	an Deck
POS501/267-1	20.06.16	09:45	33° 00,04' N	021° 00,01' W	5147,5	ENE 8	353,4	0,3	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/267-1	20.06.16	15:18	32° 59,91' N	020° 59,81' W	5167,3	NE 7	235,0	0,2	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 5224 m
POS501/267-1	20.06.16	16:54	32° 59,99' N	021° 00,02' W	5144,1	ENE 8	317,6	0,2	CTD/rosette water sampler	CTD/RO	an Deck
POS501/268-1	21.06.16	00:13	34° 00,00' N	021° 00,07' W	5174,1	NNE 5	309,1	0,9	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/268-1	21.06.16	01:53	34° 00,01' N	021° 00,02' W	5174,1	NNE 4	179,0	0,1	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max: 5289 m
POS501/268-1	21.06.16	03:27	33° 59,97' N	020° 59,96' W	5173,4	N 6	358,1	0,2	CTD/rosette water sampler	CTD/RO	an Deck
POS501/269-1	21.06.16	06:55	34° 30,01' N	021° 00,00' W	5191,0	ENE 3	333,3	0,5	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/269-1	21.06.16	07:21	34° 30,01' N	020° 59,98' W	5194,4	NE 4	99,8	0,2	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 555 m
POS501/269-1	21.06.16	07:32	34° 30,03' N	020° 59,99' W	5192,9	NE 4	305,6	0,8	CTD/rosette water sampler	CTD/RO	an Deck
POS501/270-1	21.06.16	11:13	34° 59,97' N	021° 00,02' W	5133,6	NNE 4	157,3	0,2	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/270-1	21.06.16	12:48	34° 59,94' N	020° 59,95' W	5134,0	NNE 4	114,9	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 5249 m
POS501/270-1	21.06.16	14:41	34° 59,98' N	020° 59,97' W	5135,0	N 4	161,9	0,0	CTD/rosette water sampler	CTD/RO	an Deck
POS501/270-2	21.06.16	15:19	34° 59,81' N	020° 59,81' W	5132,8	N 4	97,5	2,9	Scan-Fish SCF		zu Wasser
POS501/270-2	21.06.16	15:30	35° 00,13' N	020° 59,31' W	5133,5	N 5	2,6	4,2	Scan-Fish SCF		Start Profil
POS501/270-2	21.06.16	18:00	35° 10,83' N	021° 00,00' W	5181,4	NNE 5	358,0	3,7	Scan-Fish SCF		Ende Profil
POS501/270-2	21.06.16	18:18	35° 12,01' N	021° 00,01' W	5184,5	NE 5	5,4	2,5	Scan-Fish SCF		an Deck
POS501/271-1	21.06.16	20:27	35° 30,03' N	021° 00,00' W	5177,2	N 4	13,8	0,8	CTD/rosette water sampler	CTD/RO	zu Wasser

POS501/271-1	21.06.16	22:01	35° 30,57' N	020° 59,64' W	5170,6	N 3	351,4	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max 5302 m
POS501/271-1	21.06.16	23:40	35° 30,98' N	020° 59,27' W	5179,5	NNW 3	19,1	0,5	CTD/rosette water sampler	CTD/RO	an Deck	
POS501/272-1	22.06.16	03:09	35° 59,94' N	020° 59,99' W	5036,7	NNE 3	144,1	0,5	CTD/rosette water sampler	CTD/RO	zu Wasser	
POS501/272-1	22.06.16	04:39	36° 00,01' N	021° 00,00' W	5036,9	NE 3	220,4	0,2	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max 5134m
POS501/272-1	22.06.16	06:04	35° 59,83' N	021° 00,03' W	5030,0	N 3	211,6	0,1	CTD/rosette water sampler	CTD/RO	an Deck	
POS501/273-1	22.06.16	09:40	36° 30,00' N	020° 59,99' W	4799,0	W 2	203,8	0,4	CTD/rosette water sampler	CTD/RO	zu Wasser	
POS501/273-1	22.06.16	09:57	36° 29,97' N	021° 00,01' W	4798,1	W 2	213,6	0,2	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max 513 m
POS501/273-1	22.06.16	10:08	36° 29,97' N	021° 00,02' W	4798,3	W 3	237,3	0,1	CTD/rosette water sampler	CTD/RO	an Deck	
POS501/274-1	22.06.16	10:09	36° 29,97' N	021° 00,02' W	4798,6	W 2	343,0	0,1	Micro structure probe	MSS	zu Wasser	
POS501/274-1	22.06.16	14:06	37° 00,11' N	021° 00,12' W	3547,5	NNE 8	250,7	0,4	Micro structure probe	MSS	an Deck	
POS501/274-2	22.06.16	14:36	37° 00,05' N	021° 00,11' W	3540,4	NNE 10	334,4	0,3	CTD/rosette water sampler	CTD/RO	zu Wasser	
POS501/274-2	22.06.16	15:40	37° 00,02' N	021° 00,01' W	3536,5	NNE 9	95,2	0,1	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max: 3595 m
POS501/274-2	22.06.16	16:41	37° 00,08' N	021° 00,01' W	3538,9	NNE 9	103,5	0,1	CTD/rosette water sampler	CTD/RO	an Deck	
POS501/275-1	22.06.16	22:26	36° 59,99' N	022° 00,02' W	4081,6	NNE 5	254,2	0,1	CTD/rosette water sampler	CTD/RO	zu Wasser	
POS501/275-1	22.06.16	23:45	36° 59,97' N	021° 59,97' W	4078,4	N 5	263,4	0,2	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max 4150 m
POS501/275-1	23.06.16	01:10	36° 59,94' N	021° 59,91' W	4075,8	NNE 6	127,8	0,5	CTD/rosette water sampler	CTD/RO	an Deck	
POS501/276-1	23.06.16	05:00	36° 30,00' N	021° 59,99' W	4031,1	N 6	140,3	0,3	CTD/rosette water sampler	CTD/RO	zu Wasser	
POS501/276-1	23.06.16	05:16	36° 30,00' N	021° 59,94' W	4031,9	NNE 5	105,3	0,4	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max 508m
POS501/276-1	23.06.16	05:25	36° 30,00' N	021° 59,96' W	4031,3	N 5	111,0	0,2	CTD/rosette water sampler	CTD/RO	an Deck	
POS501/277-1	23.06.16	09:03	36° 00,00' N	021° 59,99' W	4212,8	NE 7	18,2	0,7	Micro structure probe	MSS	zu Wasser	
POS501/277-1	23.06.16	09:11	36° 00,09' N	021° 59,91' W	4200,0	NNE 6	28,1	0,9	Micro structure probe	MSS	auf Tiefe	Tiefe 417 m
POS501/277-1	23.06.16	09:26	36° 00,24' N	021° 59,72' W	4168,9	NNE 5	55,1	0,9	Micro structure probe	MSS	auf Tiefe	Tiefe 438 m
POS501/277-1	23.06.16	09:40	36° 00,37' N	021° 59,56' W	4138,5	NNE 5	52,5	1,0	Micro structure probe	MSS	auf Tiefe	Tiefe 423 m
POS501/277-1	23.06.16	09:59	36° 00,53' N	021° 59,34' W	4123,3	NNE 6	45,8	0,8	Micro structure probe	MSS	auf Tiefe	Tiefe 433 m
POS501/277-1	23.06.16	10:15	36° 00,69' N	021° 59,14' W	4102,0	NE 6	47,3	0,9	Micro structure probe	MSS	auf Tiefe	Tiefe 433 m
POS501/277-1	23.06.16	10:30	36° 00,85' N	021° 59,01' W	4088,8	NE 6	31,3	0,6	Micro structure probe	MSS	auf Tiefe	Tiefe 439 m
POS501/277-1	23.06.16	10:39	36° 00,91' N	021° 58,93' W	4086,5	NNE 7	58,3	0,6	Micro structure probe	MSS	an Deck	
POS501/277-2	23.06.16	14:23	36° 00,04' N	022° 00,13' W	4197,3	NE 4	299,9	0,2	CTD/rosette water sampler	CTD/RO	zu Wasser	
POS501/277-2	23.06.16	15:40	35° 59,90' N	022° 00,17' W	4216,8	NE 6	195,8	0,5	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max 4290 m
POS501/277-2	23.06.16	16:50	35° 59,60' N	022° 00,51' W	4271,4	NE 7	235,6	0,8	CTD/rosette water sampler	CTD/RO	an Deck	
POS501/278-1	23.06.16	20:33	35° 29,99' N	021° 59,94' W	4937,0	NE 7	136,6	0,8	CTD/rosette water sampler	CTD/RO	zu Wasser	
POS501/278-1	23.06.16	20:49	35° 29,94' N	021° 59,88' W	4937,4	NE 7	136,9	0,4	CTD/rosette water sampler	CTD/RO	auf Tiefe	SL max 509 m

POS501/278-1	23.06.16	21:06	35° 29,75' N	021° 59,67' W	4937,1	NE 8	195,4	7,9	CTD/rosette water samplerCTD/RO		an Deck
POS501/279-1	24.06.16	00:32	34° 59,96' N	021° 59,99' W	5013,8	NE 9	145,6	0,5	CTD/rosette water samplerCTD/RO		zu Wasser
POS501/279-1	24.06.16	02:08	35° 00,07' N	021° 59,83' W	5015,3	NE 9	42,2	0,3	CTD/rosette water samplerCTD/RO		auf Tiefe SL max: 5122 m
POS501/279-1	24.06.16	03:30	35° 00,06' N	021° 59,75' W	5015,5	NE 7	171,3	0,1	CTD/rosette water samplerCTD/RO		an Deck
POS501/280-1	24.06.16	10:30	34° 00,00' N	022° 00,04' W	5286,0	NE 8	81,9	0,2	CTD/rosette water samplerCTD/RO		zu Wasser
POS501/280-1	24.06.16	10:46	33° 59,98' N	022° 00,07' W	5286,1	NE 9	33,6	0,4	CTD/rosette water samplerCTD/RO		auf Tiefe SL max 513 m
POS501/280-1	24.06.16	10:59	33° 59,96' N	022° 00,07' W	5285,6	NE 10	179,8	0,0	CTD/rosette water samplerCTD/RO		an Deck
POS501/280-2	24.06.16	11:10	34° 00,13' N	021° 59,99' W	5286,6	NE 10	340,1	2,2	Scan-Fish SCF		zu Wasser
POS501/280-2	24.06.16	11:22	34° 00,61' N	022° 00,09' W	5297,1	NE 10	3,4	3,7	Scan-Fish SCF		Start Profil
POS501/280-2	24.06.16	19:22	34° 32,82' N	022° 00,01' W	5153,8	NE 10	359,2	3,8	Scan-Fish SCF		Ende Profil
POS501/280-2	24.06.16	19:58	34° 33,71' N	021° 58,91' W	5143,1	NE 9	48,0	2,2	Scan-Fish SCF		an Deck
POS501/281-1	25.06.16	07:32	33° 00,05' N	022° 00,04' W	5213,6	ENE 11	353,5	0,5	CTD/rosette water samplerCTD/RO		zu Wasser
POS501/281-1	25.06.16	09:05	33° 00,05' N	022° 00,05' W	5216,1	ENE 11	259,9	0,2	CTD/rosette water samplerCTD/RO		auf Tiefe SL max 5327 m
POS501/281-1	25.06.16	10:51	33° 00,03' N	022° 00,02' W	5213,7	NE 10	226,0	0,2	CTD/rosette water samplerCTD/RO		an Deck
POS501/281-2	25.06.16	11:11	33° 00,03' N	021° 59,78' W	5216,4	NE 11	113,7	0,7	Micro structure probe MSS		zu Wasser
POS501/281-2	25.06.16	11:22	33° 00,02' N	021° 59,58' W	5215,4	NE 10	86,9	1,0	Micro structure probe MSS		auf Tiefe
POS501/281-2	25.06.16	11:27	33° 00,02' N	021° 59,47' W	5227,9	NE 11	90,9	1,0	Micro structure probe MSS		Oberfläche
POS501/281-2	25.06.16	11:38	33° 00,02' N	021° 59,24' W	5213,9	NE 11	91,0	0,9	Micro structure probe MSS		auf Tiefe
POS501/281-2	25.06.16	12:20	33° 00,07' N	021° 58,43' W	5215,1	ENE 11	84,7	1,0	Micro structure probe MSS		Oberfläche
POS501/281-2	25.06.16	12:41	33° 00,09' N	021° 58,07' W	5214,7	NE 10	77,9	1,0	Micro structure probe MSS		auf Tiefe
POS501/281-2	25.06.16	13:10	33° 00,12' N	021° 57,54' W	5228,8	NE 12	88,3	0,9	Micro structure probe MSS		an Deck
POS501/282-1	25.06.16	20:47	32° 00,00' N	021° 59,98' W	5052,0	ENE 10	221,5	0,1	CTD/rosette water samplerCTD/RO		zu Wasser
POS501/282-1	25.06.16	22:17	32° 00,22' N	021° 59,70' W	5069,1	NE 10	353,3	0,4	CTD/rosette water samplerCTD/RO		auf Tiefe SL max 5178 m
POS501/282-1	25.06.16	23:52	32° 00,54' N	021° 59,34' W	5052,6	NE 10	57,4	0,4	CTD/rosette water samplerCTD/RO		an Deck
POS501/283-1	26.06.16	06:15	31° 59,98' N	023° 00,00' W	5267,0	NE 9	190,9	0,1	CTD/rosette water samplerCTD/RO		zu Wasser
POS501/283-1	26.06.16	06:31	31° 59,96' N	022° 59,99' W	5272,2	ENE 8	355,4	0,4	CTD/rosette water samplerCTD/RO		auf Tiefe SL max 530 m
POS501/283-1	26.06.16	06:49	31° 59,90' N	022° 59,95' W	5270,1	ENE 8	209,4	0,2	CTD/rosette water samplerCTD/RO		an Deck
POS501/284-1	26.06.16	14:34	32° 59,99' N	023° 00,02' W	5321,9	NE 9	151,0	0,5	CTD/rosette water samplerCTD/RO		zu Wasser
POS501/284-1	26.06.16	16:09	33° 00,04' N	022° 59,95' W	5321,0	NE 9	23,2	0,2	CTD/rosette water samplerCTD/RO		auf Tiefe SL max: 5442 m
POS501/284-1	26.06.16	17:55	33° 00,00' N	023° 00,07' W	5325,0	NE 8	307,0	0,2	CTD/rosette water samplerCTD/RO		an Deck
POS501/284-2	26.06.16	18:12	33° 00,00' N	023° 00,08' W	5329,5	NE 9	319,4	0,1	Micro structure probe MSS		zu Wasser
POS501/284-2	26.06.16	18:22	33° 00,11' N	023° 00,00' W	5323,8	NE 8	30,1	0,8	Micro structure probe MSS		auf Tiefe Tiefe 429m

POS501/284-2	26.06.16	18:40	33° 00,31' N	022° 59,81' W	5321,1	NE 7	32,1	0,5	Micro structure probe	MSS	auf Tiefe Tiefe 420 m
POS501/284-2	26.06.16	18:59	33° 00,49' N	022° 59,61' W	5315,8	NE 7	45,7	1,4	Micro structure probe	MSS	auf Tiefe Tiefe 420 m
POS501/284-2	26.06.16	19:34	33° 00,81' N	022° 59,25' W	5318,3	NE 6	34,2	0,8	Micro structure probe	MSS	auf Tiefe Tiefe 420 m
POS501/284-2	26.06.16	19:51	33° 00,97' N	022° 59,09' W	5317,0	NE 6	42,4	0,9	Micro structure probe	MSS	auf Tiefe Tiefe 420 m
POS501/284-2	26.06.16	19:58	33° 01,03' N	022° 59,04' W	5316,1	ENE 6	45,6	0,5	Micro structure probe	MSS	an Deck
POS501/285-1	26.06.16	23:59	33° 30,00' N	023° 00,03' W	5339,3	ENE 6	128,2	0,3	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/285-1	27.06.16	00:18	33° 29,98' N	023° 00,09' W	5334,8	NE 7	276,8	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max: 518 m
POS501/285-1	27.06.16	00:35	33° 30,03' N	023° 00,02' W	5340,4	NE 8	32,6	0,6	CTD/rosette water sampler	CTD/RO	an Deck
POS501/286-1	27.06.16	04:47	34° 00,00' N	023° 00,00' W	5299,1	NE 8	353,9	0,3	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/286-1	27.06.16	06:15	34° 00,01' N	023° 00,02' W	5309,1	NE 11	85,8	0,2	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 5413 m
POS501/286-1	27.06.16	07:39	33° 59,95' N	023° 00,01' W	5299,6	NE 11	224,5	0,5	CTD/rosette water sampler	CTD/RO	an Deck
POS501/287-1	27.06.16	11:48	34° 30,01' N	022° 59,99' W	5144,9	NE 11	95,9	0,1	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/287-1	27.06.16	12:06	34° 30,03' N	022° 59,92' W	5160,5	NE 11	29,2	0,6	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 520 m
POS501/287-1	27.06.16	12:18	34° 29,99' N	022° 59,92' W	5163,8	NE 10	228,8	0,7	CTD/rosette water sampler	CTD/RO	an Deck
POS501/288-1	27.06.16	16:44	35° 00,00' N	022° 59,98' W	4906,4	NE 9	295,1	0,3	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/288-1	27.06.16	18:05	34° 59,97' N	022° 59,93' W	4926,9	NE 11	332,9	0,3	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 4963 m
POS501/288-1	27.06.16	19:24	34° 59,92' N	022° 59,70' W	4786,0	NE 12	100,6	0,8	CTD/rosette water sampler	CTD/RO	an Deck
POS501/288-2	27.06.16	19:38	35° 00,01' N	022° 59,56' W	4706,5	NE 11	56,8	0,9	Micro structure probe	MSS	zu Wasser
POS501/288-2	27.06.16	19:49	35° 00,09' N	022° 59,46' W	4681,9	NE 11	29,9	0,9	Micro structure probe	MSS	auf Tiefe Tiefe 449 m
POS501/288-2	27.06.16	20:06	35° 00,23' N	022° 59,27' W	4546,9	NE 11	38,8	0,5	Micro structure probe	MSS	auf Tiefe Tiefe 432 m
POS501/288-2	27.06.16	20:24	35° 00,36' N	022° 58,94' W	4663,0	NE 13	59,6	1,3	Micro structure probe	MSS	auf Tiefe
POS501/288-2	27.06.16	20:43	35° 00,48' N	022° 58,63' W	4944,7	NE 11	78,4	1,0	Micro structure probe	MSS	auf Tiefe
POS501/288-2	27.06.16	21:01	35° 00,60' N	022° 58,28' W	5003,7	NE 11	82,4	1,0	Micro structure probe	MSS	auf Tiefe
POS501/288-2	27.06.16	21:20	35° 00,70' N	022° 57,89' W	4970,1	NE 13	91,1	1,1	Micro structure probe	MSS	auf Tiefe
POS501/288-2	27.06.16	21:50	35° 00,83' N	022° 57,33' W	4970,1	NE 13	68,0	1,1	Micro structure probe	MSS	an Deck
POS501/289-1	28.06.16	05:36	34° 30,03' N	022° 00,03' W	5139,7	NE 13	140,3	0,5	CTD/rosette water sampler	CTD/RO	zu Wasser
POS501/289-1	28.06.16	07:01	34° 29,99' N	022° 00,01' W	5159,5	NE 14	205,8	0,4	CTD/rosette water sampler	CTD/RO	auf Tiefe SL max 5234 m
POS501/289-1	28.06.16	08:26	34° 30,01' N	022° 00,01' W	0,0	NE 12	119,5	1,0	CTD/rosette water sampler	CTD/RO	an Deck
POS501/289-2	28.06.16	08:46	34° 30,24' N	021° 59,86' W	5160,6	NE 12	11,5	3,0	Scan-Fish SCF		zu Wasser
POS501/289-2	28.06.16	08:58	34° 30,85' N	021° 59,80' W	5155,7	NE 15	356,9	3,8	Scan-Fish SCF		Start Profil
POS501/289-2	28.06.16	19:30	35° 09,75' N	022° 00,01' W	4990,9	NNE 12	350,9	3,6	Scan-Fish SCF		Ende Profil
POS501/289-2	28.06.16	20:02	35° 11,54' N	022° 00,62' W	4997,4	NE 12	333,3	2,6	Scan-Fish SCF		an Deck

POS501/290-1	**29.06.16**	**09:57**	**33° 59,99' N**	**023° 59,98' W**	**4937,2**	**NNE 9**	**103,8**	**0,5**	**CTD/rosette water samplerCTD/RO**	**zu Wasser**	
POS501/290-1	**29.06.16**	**11:24**	**33° 59,98' N**	**023° 59,88' W**	**4997,3**	**NE 8**	**338,0**	**0,4**	**CTD/rosette water samplerCTD/RO**	**auf Tiefe**	**SL max 5074 m**
POS501/290-1	**29.06.16**	**16:19**	**34° 00,14' N**	**024° 00,12' W**	**4953,6**	**NNE 7**	**2,9**	**0,3**	**CTD/rosette water samplerCTD/RO**	**an Deck**	
POS501/291-1	**30.06.16**	**03:21**	**34° 59,98' N**	**022° 59,99' W**	**4918,5**	**NNE 7**	**67,9**	**0,5**	**CTD/rosette water samplerCTD/RO**	**zu Wasser**	
POS501/291-1	**30.06.16**	**03:35**	**34° 59,94' N**	**022° 59,91' W**	**4865,3**	**N 9**	**6,6**	**0,3**	**CTD/rosette water samplerCTD/RO**	**auf Tiefe**	**SL max: 510 m**
POS501/291-1	**30.06.16**	**03:49**	**35° 00,01' N**	**022° 59,95' W**	**4852,3**	**NNE 10**	**203,6**	**0,5**	**CTD/rosette water samplerCTD/RO**	**an Deck**	
POS501/292-1	**30.06.16**	**07:49**	**35° 29,96' N**	**022° 59,99' W**	**4210,5**	**NNE 9**	**358,8**	**0,7**	**CTD/rosette water samplerCTD/RO**	**zu Wasser**	
POS501/292-1	**30.06.16**	**08:03**	**35° 29,98' N**	**022° 59,97' W**	**4208,7**	**N 8**	**155,4**	**0,1**	**CTD/rosette water samplerCTD/RO**	**auf Tiefe**	**SL max 529 m**
POS501/292-1	**30.06.16**	**08:13**	**35° 29,97' N**	**022° 59,90' W**	**4218,6**	**NNE 6**	**115,8**	**0,7**	**CTD/rosette water samplerCTD/RO**	**an Deck**	
POS501/293-1	**30.06.16**	**12:08**	**35° 59,96' N**	**022° 59,98' W**	**4407,6**	**NNW 7**	**13,8**	**0,9**	**CTD/rosette water samplerCTD/RO**	**zu Wasser**	
POS501/293-1	**30.06.16**	**12:26**	**36° 00,03' N**	**023° 00,01' W**	**4413,2**	**N 8**	**230,6**	**0,1**	**CTD/rosette water samplerCTD/RO**	**auf Tiefe**	**SL max: 563 m**
POS501/293-1	**30.06.16**	**12:40**	**36° 00,06' N**	**023° 00,00' W**	**4410,9**	**N 8**	**54,9**	**0,4**	**CTD/rosette water samplerCTD/RO**	**an Deck**	

End the station work POS 501